

Business Offer Driven Dynamic Web Service Selection

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Abstract- In today's business environment, the business offers have an inevitable importance in giving the buyer the most profitable deal. In order to improve the business, the service providers attract the customers by advertising a lot of attractive offers. There is a need for the selection mechanism which accepts the requester's various requirements on business offers to find the most profitable service. In this paper, we identify various business offers of service providers in e-business domain and broadly classify them based on requester's point of view as, unconditional business offers, conditional business offers and probabilistic business offers. We also provide a vocabulary for various business offers of service providers. The paper explores different types of requester's requirements on business offers and proposes a language to express such requirements on various business offers. We propose a tree structure to represent requester's complex business offer requirements for the business offer driven Web service selection.

I. INTRODUCTION

Web services technology promise to facilitate an efficient execution and coordination of B2B and B2C e-commerce by integrating business applications over Internet. A Web service is an interface that describes a collection of operations that are network accessible through standardized XML messaging [1]. The present Web service architecture is based on the interactions between three roles i.e. service provider, service registry and service requester. The interactions among them involve publish, find and bind operations [1]. The Web service discovery mechanism facilitates the requester to gain an access to Web services satisfying his functional requirements. The existence of numerous Web service providers over the Web, results in Web services with similar or same functionality. This makes the requester, to use techniques and tools to select the Web services based on his non-functional requirements. The Web service selection is the process of choosing a Web service from functionally similar Web services which satisfies requester's non-functional requirements. Most of the selection mechanisms described in literature deals with only generic QoS criteria of Web services to distinguish functionally similar Web services. A few researchers have proposed the business qualities like price, compensation rate etc. to select best Web services [3] [4]. In business driven Web services, the provider of the service tries to attract more consumers by advertising many business offers. The various Web service selection methods discussed in literature, neglect the requester's requirements on service provider's business offerings. In this

paper, we propose a language and business offer model to publish and query (select) the business driven Web services based on their offers.

A. Motivating Example

Consider the book buying from several online book suppliers. In order to attract book buyers, the book suppliers (sellers) advertise many attractive gifts/offers. For example, a book seller may offer 10% reduction on every purchase. Similarly, book seller may offer a free magazine on book purchase. On the other side, the book buyers will be having several requirements on the business offers advertised by different book sellers. For example, the buyer may prefer a discount than a free gift. The buyer may also prefer a lucky coupon or warranty options or a free gift etc. for the purchase. In such e-business environments, we need to identify a mechanism to publish business offer driven Web services and a model to represent requester's complex requirements on business offers for the selection.

B. Contribution

To automate the business offer driven selection mechanism of Web services in e-business scenario, we need to identify the solutions for the following issues.

- (a) How to express the business offers of service providers?
- (b) How to represent the different business offers in computer readable form?
- (c) How to express and represent requester's different requirements on various business offers?

In this paper, we try to give the solutions to these problems.

The contributions of this paper are:

1. Definition and categorization of various business offers in e-business domain
2. Information model to represent service provider's various business offers
3. A language to represent requester's requirements on provider's business offers
4. A tree structure to represent requester's requirements on multiple business offers.

The rest of the paper is organized as follows: In section 2, we discuss various business offers of Web service providers. Section 3 describes the information model for business offers. In Section 4, we describe the requester's various offering requirements. Section 5 proposes the tree model for requester's

requirements on business offers. Section 6 draws the conclusions.

II. A BUSINESS OFFER MODEL FOR BUSINESS WEB SERVICES

In today's e-business environment, the business offers (offerings) have an inevitable importance in giving the buyer the most profitable deal. In order to attract customers in good numbers, the service providers normally advertise a lot of attractive offers to improve their business and thereby a profit. We define the business offer as a reduction in the price of commodity to be purchased or giving same/other commodity as a gift on purchase. In this section, we define the business offer vocabulary from requester's point of view and categorize various business offers as *Unconditional Business Offers*, *Conditional Business Offers* and *Probabilistic Business Offers*.

A. Unconditional Business Offer

Unconditional business offers are delivered without any prior or post conditions on the business (purchase). This type of business offer is further classified as *Value based Business Offers* and *Commodity based Business Offers*.

1) *Value based Business Offer*. Value based business offers are normally consists of unconditional discounts or cash gifts on purchased item/service. We further classify value based business offers as *Cash based Business Offers* and *Discount based Business Offers*.

(i) *Cash based Business Offer (UC)*. In cash based business offers, the providers will advertise a gift cheque or cash on every purchase of goods/services. For example, on every book purchase, the seller may offer a gift cheque of worth \$15.

(ii) *Discount based Business Offer (UD)*. A discount based business offers involve a reduction in price (discount) on every purchase of goods/services. A discount is normally expressed in terms of percentage of selling price of goods/services. For example, a book seller may offer 10% discount on all purchases.

2) *Commodity based Business Offer*. A commodity based business offer normally consists of gifts in the form of an item (goods) or service on purchase of specific commodity. For example, on book buying, the seller may offer a marker pen or a magazine as a free gift. We define the following two types of commodity based business offers.

(i) *Article based Business Offer (UA)*. In an article based business offer, the seller gives the purchased article as a gift or any other article as a gift on purchase. For example, the seller may offer a free pen on purchase of pen (buy one get one free). Similarly cloth seller may offer a free T-shirt on purchase of a trouser.

(ii) *Service based Business Offer (US)*. A service based business offer normally delivers a service as a gift for the purchase. For example, a seller may offer two free technical services of worth \$50 on the purchase of an electronic item.

B. Conditional Business Offer

The conditional business offers are either value based or commodity based business offers such that, the seller imposes a pre-condition to enjoy the business offer. The pre-condition is a relational expression defined on the quantity of business or price involving relational operators like $>$ and \geq . We categorize conditional business offers as *Quantity based Business Offers* and *Sum based Business Offers*.

1) *Quantity based Business Offer*. In quantity based business offers, the condition is defined on the quantity (in terms of numbers) of business transaction. For example, to get an offer of one free shirt, the buyer has to buy a minimum of 2 shirts (Buy 2; get one free). We identify *four* different types of quantity based business offers depending on the value and commodity involved in the business offer.

(i) *Quantity-Cash based Business Offer (QC)*. The example for this type of business offer is, "buy 2 televisions, and get \$50 worth gift cheque". Similarly the free gift cheque of worth \$15 on purchase of two shirts is another example for quantity-cash based business offer.

(ii) *Quantity-Discount based Business Offer (QD)*. In this type of offer, for the specified quantity of purchase, a discount is offered on the total transaction. For example, "buy 2 shirts and get 5% discount".

(iii) *Quantity-Article based Business Offer (QA)*. This business offer involves a pre-condition which is defined on the quantity of business transaction. For example, "Buy 2 shirts and get one T-shirt free" is a quantity-article based business offer. Here the offered article can be the purchased item or any other item of equivalent value or different value.

(iv) *Quantity-Service based Business Offer (QS)*. In this type of business offer, the requester has to perform a business transaction of specified quantity to get a free service offer. "Reserve 5 train tickets, and get one free reservation" is an example for quantity-service based business offer.

2) *Sum based Business Offer*. In the business offer, if the condition is defined on the transaction amount (sum) then, the business offer is called as sum based business offer. For example, to get a discount of 10% on the bag, the seller may require a total business above \$280 from the buyer. Depending on type of value or commodity involved in the sum based business offers, we identify *four* types of sum based business offers.

(i) *Sum-Cash based Business Offer (SC)*. The example for this type of business offer is, "buy books of worth \$100 and get a gift cheque of worth \$5". Similarly the seller advertisement of free gift cheque of worth \$15 on purchase of shirts of worth \$120 is another example for sum-cash based business offer.

(ii) *Sum-Discount based Business Offer (SD)*. In this type of business offer, a discount of specific amount (percentage) is offered on the total transaction amount. For example, "buy shirts of worth \$200 and get 8% discount on the total transaction".

(iii) *Sum-Article based Business Offer (SA)*. This type of business offer involves a pre-condition defined on the amount of business transaction. For example, "Buy shirts of worth \$60 and get one T-shirt free" is a sum-article based business offer.

(iv) *Sum-Service based Offer (SS)*. In this type of business offer, the requester has to perform a business transaction of specified amount to get a free service offer.

C. Probabilistic Business Offer

Probabilistic business offers are either conditional or unconditional in nature. In these business offers, the delivery of an offer is probabilistic in nature and the offer is normally valid for some pre-defined period (days/months/years). We define four types of probabilistic business offers.

1) *Quantity based Lucky Coupon Offer (QL)*. This is a conditional business offer where, a lucky coupon offer is valid for the purchase of a specified quantity of items. For example, the seller may offer a lucky coupon of worth \$400 on every purchase of 5 leather bags.

2) *Sum based Lucky Coupon Offer (SL)*. It is conditional offer where, the lucky coupon offer is valid for a given period based on the transaction amount. For example, the seller may advertise a lucky coupon of worth \$800 on purchase of items of worth above \$99.

3) *Unconditional Lucky Coupon Offer (UL)*. This is an offer where the lucky coupon is given on every purchase of commodity/service without any restriction. For example, the seller may offer a lucky coupon (Malaysia tour) of worth \$500 on every book purchase.

4) *Warranty Period Offer (WP)*. The warranty period offer normally related to the delivery of technical service to the customer in the event of breakdown of the bought product/item. The warranty period is a business offer, which is expressed in terms of months or years that represent the duration of the free technical service. For example, the seller may offer 3 (36 months) years of warranty for the purchased electronic goods.

III. INFORMATION MODEL FOR BUSINESS OFFERS

In this section, we present the data model to store various offers of business Web services advertised by a numerous service providers. According to the UDDI specification [2], the business provider can publish any number of Web services. We extend the UDDI information model to represent various business offers by adding a new data structure (entity) under the business service *entity* called *Service Offer*. A Web service can advertise any number of business offers. For example, a book seller can offer 10% reduction on every purchase and a lucky coupon of worth \$100 on purchase of worth above \$399. The service offer entity (data structure) holds the following mandatory information for all business offers. These are-*Offer Id* (Unique Identifier), *Offer Type* (string), *Item/service Name* (string), *Item/service Value* (currency), *Offer Start Time* (date), and *Offer End Time* (date). Similarly the service offer entity also holds the following additional information which is

dependent on offer type (Refer Table 1). The business offer vocabulary defined in this data model has to be used by all Web service providers and requesters for the business offer-aware Web service publishing and selection.

We observe that, the unconditional business offers are characterized with one business offer dependent information parameter i.e. *Amount*. The conditional business offers are characterized with two information parameters i.e. *Amount* and *Sum*. Similarly, the probabilistic business offers take one or two offer dependent information parameters. If the business offer is characterized with single offer dependent information parameter then such a business offer is called as *Atomic Business Offer* otherwise it is called as *Non-atomic Business Offer*. For example, value based business offers are atomic business offers whereas, conditional business offers are non-atomic business offers.

TABLE I
BUSINESS OFFER SPECIFIC INFORMATION

Offer Type		Information
Value based Business Offers	UC	Cash value (Amount)
	UD	Discount (Amount)
Commodity based Business Offers	UA	Gift value (Amount)
	US	Service value (Amount)
Quantity based Business Offers	QC	Cash value (Amount) & Quantity
	QD	Discount (Amount) & Quantity
	QA	Gift value (Amount) & Quantity
	QS	Service value (Amount) & Quantity
Sum based Business Offers	SC	Cash value (Amount) & Sum
	SD	Discount (Amount) & Sum
	SA	Gift value (Amount) & Sum
	SS	Service value (Amount) & Sum
Warranty based Business Offers	WP	Warranty period (days/months/years)
Probabilistic business Offers	UL	Coupon value (Amount)
	QL	Coupon value (Amount) & Quantity
	SL	Coupon value (Amount) & Sum

IV. REQUESTER'S CONSTRAINTS ON BUSINESS OFFERS

The Web service requester normally expects some requirements on the business offers to be satisfied by the providers. We define the business offer constraint as a requester's requirement on service provider's business offerings. Formally, business offer constraint is a relational expression defined on Web service provider's business offers. For example a book buyer may be having business offer constraint like "I need 10% discount on every purchase or a gift of worth \$10". The business offer constraints are normally different for individual requesters. For example, consider book buying scenario where, the book buyer normally looks for a discount on price but some buyers focus only on free gifts such as free pen or free magazine or lucky coupons. Thus Web service requesters can have different requirements on various

business offers. In this section, we categorize the requester's business offer constraints based on the constraint structure as *Simple Business Offer Constraint* and *Composite Business Offer Constraint*.

A. Simple Business Offer Constraint

A simple business offer constraint normally deals with one business offer. For example, the requester might say "I need a book seller service who offers a free magazine of worth \$5". This is a simple business offer constraint which can be written as " $UA \geq 5$ ". A simple business offer constraint takes the following format: $O_i \text{ cp } V_i$ where, O_i refers to atomic or non-atomic business offer, cp refers to comparison operator ($>$ and \geq) and V_i refers to expected value(s) of O_i . A simple business offer constraint is further classified based on nature of business offer O_i . If the requested business offer is atomic in nature then the simple business offer constraint is called as *Atomic Business Offer Constraint*. The simple business offer constraint defined on non-atomic business offer is called as *Non-atomic Business Offer Constraint*. For example, consider the book buyer's requirements as "book seller who offers 20% discount for the transaction amount above \$200". This is non-atomic business offer constraint which is represented as " $SD > 20, 200$ ". In this example, the value 20 refers to the parameter discount and the value 200 refers to the parameter sum as defined in the business offer vocabulary.

B. Composite Business Offer Constraint

A composite business offer constraint is composed of multiple simple business offer constraints using constraint composition operators AND and OR. For example, the requester might say "I am interested in a book seller service that offers 20% plus discount and offers a lucky coupon of worth \$100". This is composite business offer constraint which can be represented as " $UD \geq 3 \text{ AND } UL \geq 100$ ". A composite business offer constraint takes the form $S_1 \text{ op } S_2 \text{ op } S_3 \text{ op } \dots \text{ op } S_p$ where, S_i refers to simple business offer constraint and op denotes constraint composition operator AND or OR. In general, the business offer constraint takes the form: $(O_i \text{ cp } V_i) (\text{op } (O_j \text{ cp } V_j))^*$. The Web service requesters can enforce either simple or composite business offer constraints during Web service selection to choose profitable services offering valuable business offers.

V. BUSINESS OFFER CONSTRAINT MODELING

Consider the requester's business offer constraint which is to be satisfied on different business offers. We propose a tree structure called *Business Offer Constraint Tree (BOCT)* to represent requester's business offer constraint defined on multiple business offers.

A. Business Offer Constraint Tree (BOCT)

A business offer constraint tree is a AND-OR tree [4] whose leaf node contains three or four information items based on nature of requested business offer. The leaf node contains the following information items: business offer O_i , comparison operator cp and expected offer value(s) V_i of O_i . The internal

node refers to constraint composition operator op i.e. AND/OR. The leaf node represents simple business offer constraint and any sub-tree rooted at internal node represents composite business offer constraint.

The requester's business offer constraint can be represented using BOCT. Consider book buying scenario, with the following requester's business offer constraints. Requester prefers a book seller who offers 10% discount and presents a lucky coupon of worth above \$500 or a free magazine of worth \$60 for the total purchase of \$500. This business offer constraint is expressed as " $UD \geq 20 \text{ AND } UL \geq 500 \text{ OR } SD \geq 60, 500$ ". The business offer constraint can be represented using BOCT as shown in Figure 1. The nodes C, D and E are found at level zero. The node B is found at level one. The level of node A computed as two (maximum of level of B & E plus one). Thus the height of BOCT is 2. The leaf node E contains four information items i.e. business offer, relational operator, value of parameter *amount* and the value of parameter *sum*. Note that, the leaf node of non-atomic business offer constraint (node E) takes a single relational operator for both the business offer specific information parameters.

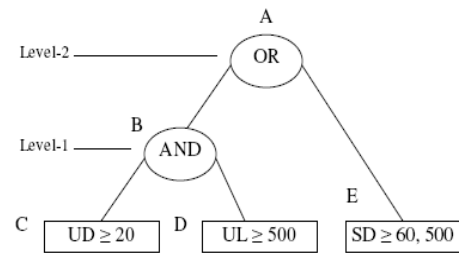


Figure 1. Business Offer Constraint Tree (BOCT) for Requester's Business Offer Constraints

VI. CONCLUSION

In e-business domain, the business offers have an inevitable importance in getting the most profitable deal. The paper explores various types of business offers advertised by a numerous business providers. We also provide an information model to publish various business offers along with business and service specific information. The paper explores a language to express requester's requirements on business offers and proposes a tree model called *Business Offer Constraint Tree (BOCT)* to represent requester's varieties of requirements on multiple business offers. As a future work, we need to identify a selection mechanism to find most profitable Web service based on requester's business offer constraints.

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